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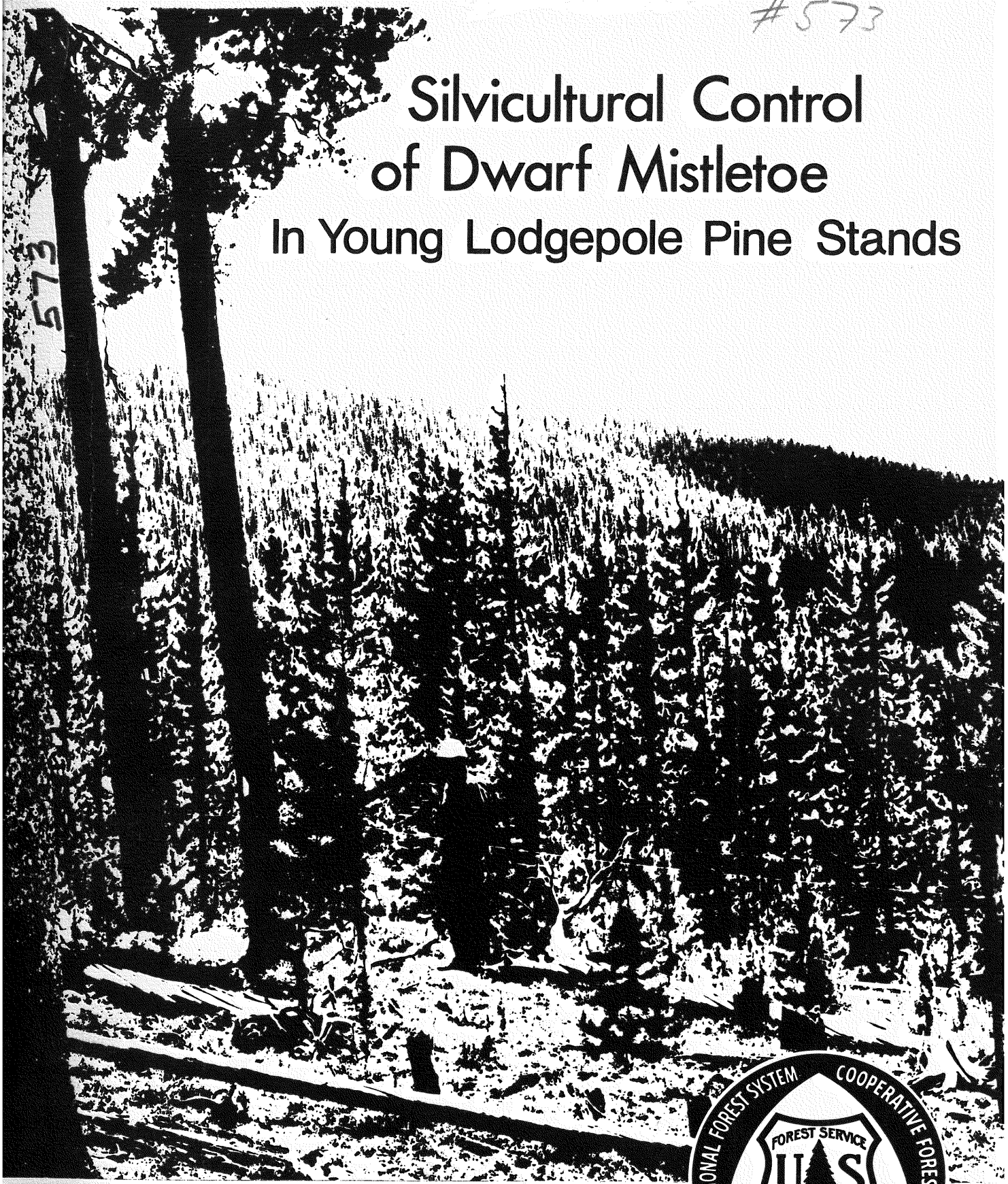

Forest Service U.S.D.A.
Rocky Mountain Region
Forest Insect and Disease Management
State and Private Forestry

SILVICULTURAL CONTROL OF DWARF MISTLETOE IN YOUNG LODGEPOLE PINE STANDS

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INTRODUCTION

In 1965 a cooperative study between the Rocky Mountain Region and the Rocky Mountain Forest and Range Experiment Station was initiated to determine the effectiveness of dwarf mistletoe (*Arceuthobium americanum* Nutt. ex. Engelm.) sanitation in young lodgepole pine (*Pinus contorta* Dougl.) stands in northern Colorado.[1/] This report records the 10-year progress of the study.

1/ Hawksworth, F. G. and W. F. Bailey. 1967. Establishment Report and Study Plan. Silvicultural control of dwarf mistletoe in young lodgepole pine stands. USDA For. Serv., Rocky Mountain Region and Rocky Mountain For. Exp. Stn., unpublished report. 12 p.

STUDY ESTABLISHMENT

A total of 37 half-acre plots were selected and established in 20-, 30-, and 40-year-old lodgepole pine stands with various degrees of dwarf mistletoe infection (Fig. 1). Plots were established in 1965 and 1966 in the Routt, Arapaho, and Roosevelt National Forests.

In each 0.5 acre plot, two intensive plots (either 0.05 or 0.025 acre, depending on stand density) were established. Dominance class, d.b.h., height, and dwarf mistletoe rating were recorded for each tree in the intensive plots. Numbers of trees and numbers infected by dwarf mistletoe were obtained for the entire 0.5 acre plot. About half the plots were sanitized at the time of establishment (Table 1), and were resanitized three years later. In each sanitation operation, all visibly infected trees were cut (Fig. 2). In addition all infected overstory trees were removed from all treated plots. Pruning was not part of the treatment. Although operational control projects might logically combine thinning and sanitation, they were kept separate here because we wanted to know the degree to which dwarf mistletoe intensified (due to development of latent and missed infections) after initial sanitation.

All sanitized plots and four mistletoe-free plots (numbers 14, 19, 23 and 34) were thinned in 1970 according to the thinning guides of the Routt National Forest (Fig. 3 and 4). In general, these called for a spacing of approximately 10 x 10 feet, or about 425 trees per acre in stands of these diameters (2-4 inches d.b.h). In some plots this spacing was not possible because the number of trees had been reduced drastically by the two sanitation treatments (Fig. 2). The work was done under contract with Forest Pest Control funds.

All plots were reexamined in 1975 and the 10-year results analyzed. The plots are scheduled for another examination in 1985. Although some plots were established in 1966 and hence provide only 9 years of data, for convenience of analyses, all data are considered to represent 10 years.

FIGURE 1 Thirty-year old lodgepole pine stand heavily infected with *Arceuthobium americanum* before treatment. Note infected overstory trees.

FIGURE 2 Forty-year old lodgepole pine stand after two sanitation treatments but before thinning.

TABLE 1

Summary of 37 plots showing their distribution by age classes, percent of trees infected with dwarf mistletoe, and treatment.

Percent infection (1965)	Treatment	Age Class - Years (1965) 15 - 24 No. of plots	25 - 34 No. of plots	35 - 44 No. of plots
None	None	1	2	2
	Thinned	1	1	2
1 - 20%	None	4	2	-
	Sanitized and Thinned	2	2	1
21 - 40%	None	2	2	-
	Sanitized and Thinned	3	2	-
41 - 60%	None	-	2	-
	Sanitized and Thinned	-	2	1
61 - 80%	None	-	-	1
	Sanitized and Thinned	-	-	2

FIGURE 3 Twenty-year old lodgepole pine stand after sanitation and thinning treatments.

FIGURE 4 Thirty-year old lodgepole pine stand after sanitation and thinning treatment.

RESULTS

The percentage of trees infected and average stand dwarf mistletoe ratings are summarized in Table 2. A more detailed breakdown of these plots is presented in Appendix I. For all treated plots the average percentage of trees infected was 31.5 before treatment in 1965 and 21.1 in 1975, a reduction of 33 percent. Comparable figures for the untreated plots were 27.9 in 1965 and 42.1 in 1975, an increase of 51 percent. Data for average dwarf mistletoe plot ratings were similar: a decrease of 40 percent in 10 years in the treated plots compared to an increase of 83 percent in the untreated ones (Table 2).

The mistletoe situation for the treated and untreated plots in 1975 is compared in Figure 5. The untreated and treated plots had similar amounts of mistletoe infection in 1965 (Table 2). In all cases the proportion of trees infected increased in the untreated plots. The results for the treated plots were variable, but in general the treated plots had much less mistletoe in 1975 than in 1965.

Data on the average d.b.h. of the trees in 1965 and 1975 on all 37 plots are given in Table 3 and Appendix II. For Table 3, the 9 check plots (mistletoe-free in 1965) were included as the data for them were essentially the same as for the 28 plots with mistletoe. The 10-year increase in d.b.h. for the treated plots (1.5 inches) was about twice that of the unthinned plots (0.7 inches). Basal area per acre data on all 37 plots in 1965 and 1976 are given in Table 3. Because of the two sanitations and subsequent thinning, which drastically reduced the number of trees, the basal area in all treated plots was lower in 1975 than in 1965. On the average, treated plots had 53 percent less basal area, while the untreated plots increased by 76 percent during the 10-year period.

DISCUSSION AND CONCLUSIONS

For all 20-year-old and most 30-year-old stands, the number of infected trees cut at the time of the second sanitation (after 4-5 years) was about one-half the percentage cut in the initial sanitation. The rate of increase apparently was not influenced

TABLE 2

Percentage of trees infected and average dwarf mistletoe rating in 1965 and 1975 in 15 treated and 13 untreated plots. Does not include 9 check plots without mistletoe. Age range in 1965.

Age class and treatment	Percent of trees infected			Dwarf mistletoe rating		
	1965	1975	Percent difference	1965	1975	Percent difference
15 - 24						
untreated (6) 1/	19.3	32.7	+ 69	0.6	1.0	+ 67
treated (5) 1/	18.2	12.2	- 33	0.2	0.2	0
25 - 34						
untreated (6)	30.0	45.7	+ 52	0.7	1.1	+ 57
treated (6)	29.7	29.7	0	0.3	0.3	0
35 - 44						
untreated (1)	67.0	77.0	+ 15	0.6	1.3	+117
treated (4)	51.0	19.5	- 38	0.9	0.4	- 56
Totals						
untreated (13)	27.9	42.1	+ 51	0.6	1.1	+ 83
treated (15)	31.5	21.1	- 33	0.5	0.3	- 40

1/ Number of plots

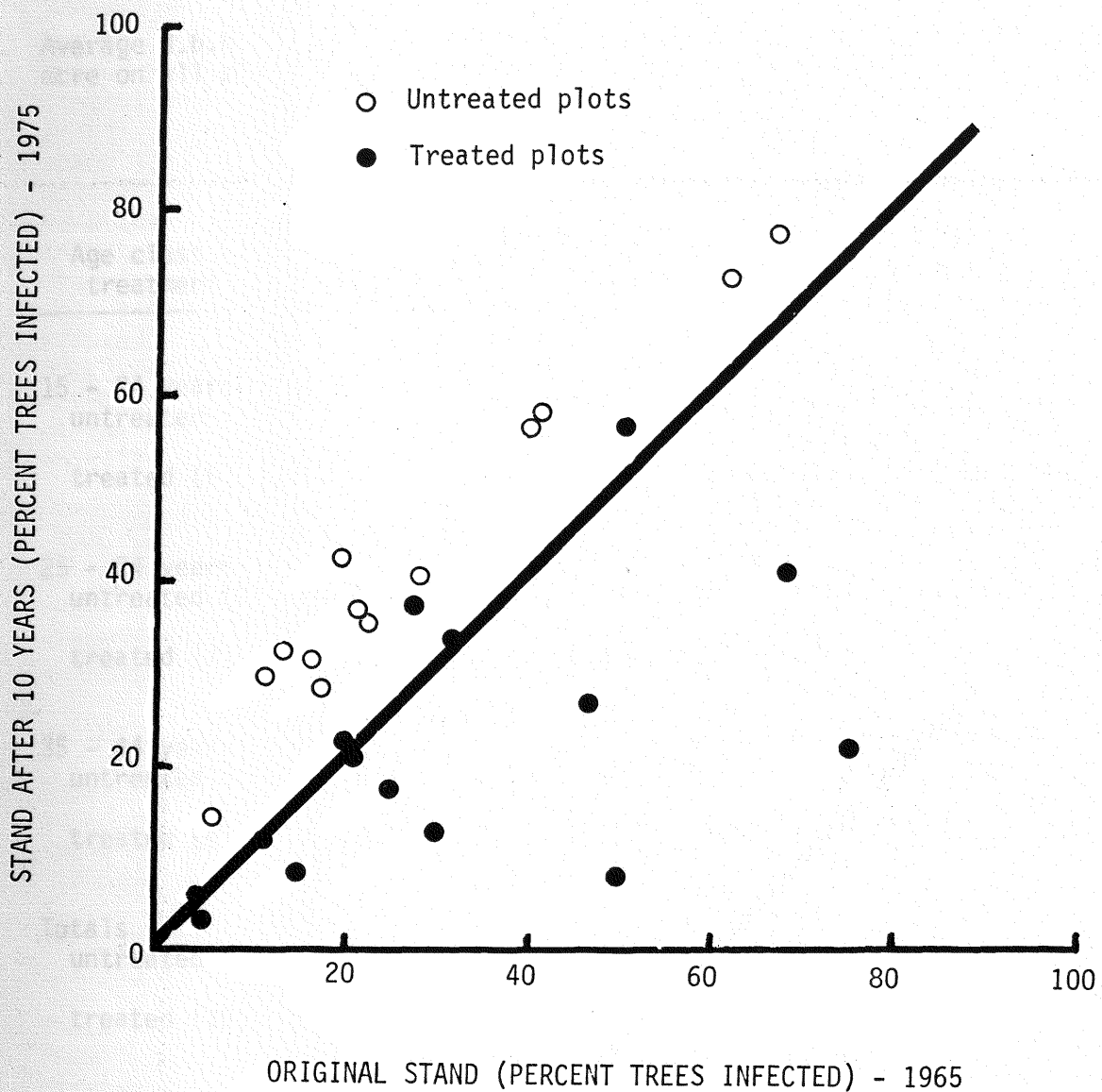

FIGURE 5 A comparison of dwarf mistletoe condition of the untreated and treated plots in 1965 and 1975.

TABLE 3

Average d.b.h. of all live trees and average basal area per acre on all plots [1/] in 1965 and 1975. Age range in 1965.

Age class and treatment	Average d.b.h. (inches)			Average basal area per acre		
	1965	1975	Percent difference	1965	1975	Percent difference
15 - 24 years						
untreated (7) [2/]	1.6	2.4	+ 50	25.7	65.3	+ 154
treated (6) [2/]	1.7	3.6	+111	28.6	24.6	- 14
25 - 34 years						
untreated (8)	2.4	3.1	+ 29	52.5	91.8	+ 75
treated (7)	2.4	4.1	+ 71	50.8	29.1	- 43
35 - 44 years						
untreated (3)	2.4	2.7	+ 12	78.0	89.8	+ 15
treated (6)	2.7	3.5	+ 30	73.4	17.1	- 77
Totals						
untreated (18)	2.1	2.8	+ 33	46.3	81.3	+ 76
treated (19)	2.3	3.8	+ 65	50.9	23.9	- 53

1/ Data for 18 treated plots and 19 untreated plots

2/ Number of plots

by the amount of infection in the original stand at the start of the study. For example, stands with 4 percent of the trees infected originally had 2 percent more infected at the second sanitation, while those with 40 percent of the trees infected originally had 20 percent more at the time of the second sanitation. This rate seems to apply to stands with up to about 50 percent of the trees infected.

The 10-year results of this study suggest that sanitation to control dwarf mistletoe is feasible in some young lodgepole pine stands. The degree of infestation in the stand, not strictly stand age, is the best criterion to decide whether sanitation is practical. A general guide from this study is that stands with more than about 40 percent of the trees infected are too heavily infected to attempt strict sanitation (removal of all infected trees). In such stands the high numbers of reinfected trees would necessitate removal of so many trees that stocking would be seriously reduced. In these studies all of the 20-year-old, and most of the 30-year-old, stands had fewer than 40 percent of the trees infected. Most of the 40-year-old stands had more than 40 percent of the trees infected, but in the one that had less than 20 percent infestation, sanitation appears to have been successful.

It is apparent from this analysis that the thinning removed more stems than is now thought to be desirable. The thinning guides called for a spacing of 10 x 10 feet (436 trees per acre), but in trees this small (2 to 4 inches d.b.h.) perhaps half again as many trees should have been left (about 650), or a spacing of 8 x 8 feet spacing.

Another complicating factor is that the thinnings removed even more trees than the guides called for. In the uninfected plots and lightly infected ones (those with less than 20 percent of the trees infected) the actual spacing achieved was closer to 11 x 11 feet or about 390 trees per acre. Of course, ideal spacing in more heavily infected plots was not possible because so many trees were removed in the two sanitations. For example, in stands with 61 to 80 percent infection, only about 110 trees per acre were left (a spacing of about 20 x 20 feet).

These plots demonstrate the effects of two strict sanitations (removal of all infected trees). Current specifications for dwarf mistletoe control in young lodgepole pine stands recommend thinning to specific growing stock levels, and leaving lightly infected trees, if necessary, to obtain the desired spacing. Studies on the long-term effects of such thinning in stands of various mistletoe intensities are being conducted by the Rocky Mountain Station.

APPENDIX

APPENDIX I Percent of trees infected and average dwarf mistletoe (DMR) ratings by age class. 1/

Percent Infection (1965)	Treatment	Year	15 - 24 No. of plots	15 - 24 Trees % Inf	15 - 24 DMR	25 - 34 No. of plots	25 - 34 Trees % Inf	25 - 34 DMR	35 - 44 No. of plots	35 - 44 Trees % Inf	35 - 44 DMR
None	None	1965	1	0	0 2/	2	0	0	2	0	0
		1975		2			1	0		0	0
	Thinned	1965	1	0	0	1	0	0	2	0	0 2/
		1975		4	0.3		0	0		.2	
1 - 20	None	1965	4	12	0.3	2	16	0.4	-	-	-
		1975		25	0.9		37	0.6	-	-	-
	Sanitized & Thinned	1965	2	8	0.1	2	12	0.4	1	11	0.1
		1975		5	0.1		13	0.4		11	0.5
21 - 40	None	1965	2	34	1.1	2	22	0.9	-	-	-
		1975		48	1.3		35	1.4	-	-	-
	Sanitized & Thinned	1965	3	25	0.3	2	29	0.1	-	-	-
		1975		17	0.3		35	0.3	-	-	-
41 - 60	None	1965	-	-	-	2	52	0.9	-	-	-
		1975	-	-	-		65	1.4	-	-	-
	Sanitized & Thinned	1965	-	-	-	2	48	0.5	1	49	1.0
		1975	-	-	-		41	0.2		7	0
61 - 80	None	1965	-	-	-	-	-	-	1	67	0.6
		1975	-	-	-	-	-	-		77	1.3
	Sanitized & Thinned	1965	-	-	-	-	-	-	2	72	1.3
		1975	-	-	-	-	-	-		30	0.6

APPENDIX II Average stand diameters (Intensive plots only) and trees per acre, by age class, in 1965 and 1975.

Percent Infection (1965)	Treatment	Year	15 - 24 No. of plots	15 - 24 Average d.b.h.(in)	15 - 24 Trees acre	25 - 34 No. of plots	25 - 34 Average d.b.h.(in)	25 - 34 Trees acre	35 - 44 No. of plots	35 - 44 Average d.b.h.(in)	35 - 44 Trees acre
None	None	1965	1	1.6	2,380	2	3.2	1,790	2	2.4	3,510
		1975		2.7	2,140		4.3	1,720		2.7	3,110
	Thinned	1965	1	2.1	1,330	1	2.7	1,700	2	2.6	2,450
		1975		4.5	320		5.0	410		3.6	440
1 - 20	None	1965	4	1.6	1,940	2	2.3	1,450	-	-	-
		1975		2.7	1,790		2.8	1,600	-	-	-
	Sanitized & Thinned	1965	2	1.4	2,480	2	2.7	1,510	1	2.5	2,800
		1975		2.8	380		4.8	340		4.1	480
21 - 40	None	1965	2	1.6	1,610	2	1.9	2,450	-	-	-
		1975		2.2	2,000		2.4	2,790	-	-	-
	Sanitized & Thinned	1965	3	1.8	1,760	2	1.8	1,720	-	-	-
		1975		3.9	350		3.2	310	-	-	-
41 - 60	None	1965	-	-	-	2	2.3	1,440	-	-	-
		1975	-	-	-		2.9	1,630	-	-	-
	Sanitized & Thinned	1965	-	-	-	2	2.5	1,780	1	2.7	1,540
		1975	-	-	-		3.6	280		2.5	220
61 - 80	None	1965	-	-	-	-	-	-	1	2.4	2,470
		1975	-	-	-	-	-	-		2.7	2,410
	Sanitized & Thinned	1965	-	-	-	-	-	-	2	3.3	1,760
		1975	-	-	-	-	-	-		3.7	110

1/ The percent of trees infected and DMR data for each plot are not directly comparable because the percentage of trees infected refers to the entire plot, while the DMR data is for the intensive portion of the plot only.

2/ less than 0.05 DMR